ORIGINAL

INVESTIGATION INTO THE ASSOCIATION BETWEEN PHYSICAL HEALTH PARAMETERS AND TONGUE IMAGE CHARACTERISTICS IN COLLEGE STUDENTS

Xuekai Liu

[1] Department of Public Course Teaching, Ningbo Polytechnic, Ningbo, Zhejiang 315800, China
E-mail: 1001068@nbpt.edu.cn

ABSTRACT

Objective: To investigate the correlation between physical health and tongue signs in college students. **Methods.** Twelve hundred and fourteen college students in the first year of a university in Ningbo were randomly selected as the study subjects, all of whom met the inclusion criteria to test their physical health and perform Chinese medicine tongue diagnosis. All collected data were later imported into an Excel sheet to create a database, and SPSS19.0 statistical software was used for data statistics and analysis. The mean of the measured data was expressed as standard deviation ±, the count data was expressed as frequency, the categorical data was expressed as X2 test, and the analysis was performed using binary logistic regression. **Results.** (1) Among each constitution type, the agreement rates from highest to lowest were: damp-heat constitution (85.17%), blood stasis constitution (83.33%), calm constitution (79.78%), yin deficiency constitution (75.68%), yang deficiency constitution (74.47%), phlegm-damp constitution (69.70%), qi deficiency constitution (65.00%), qi-yu constitution (0.00%), special endowment physique (0.00%). (2) The two factors of gender and obesity had a small effect on the agreement rate of the results of the tongue image and health status questionnaire in identifying TCM constitution, and the difference was not statistically significant (p>0.05). (3) Two factors, the degree of understanding of the health status questionnaire and the environment in which the tongue images were taken, had a greater influence on the agreement rate between the tongue images and the health status questionnaire in identifying the TCM

physique, and the difference was statistically significant (p < 0.05). (4) Logistic regression analysis showed that lung capacity, sitting forward bend, 1000m, standing long jump for boys, 50m and 800m for girls were the influencing factors of normal tongue image. **Conclusion.** There is a correlation between the physical health status of college students and tongue signs, so the method of using tongue sign analysis to identify TCM physique has a high feasibility.

KEYWORDS: physical health; tongue image; Zang-fu function

1. INTRODUCTION

Chinese civilization has a long history and a long history of origins, and traditional Chinese medicine has been handed down with the development of history to this day, forming a solid theoretical foundation for Chinese medicine. Unlike Western medicine, TCM requires a comprehensive understanding and systematic grasp of disease related information to guide clinical treatment, which is a perfect complement to Western medicine. The unique four diagnostic methods (looking, smelling, asking, and cutting) are said to be the four basic methods of diagnosing diseases, namely, looking, smelling, asking, and cutting, which are collectively called the "four diagnostic methods" (Z. Wang, 2021; Zongxi, 2021), based on the experience passed down by the folk and his years of medical practice. Tongue diagnosis is an important part of the diagnosis, and it is also an effective treatment method for the doctor to understand the changes of the patient's body through tongue images (Guo, Tang, & Li, 2020; Qian, Yan, & Li, 2021).

With the rapid development of China's economy and the improvement of people's living standards, people gradually realize the importance of health based on the satisfaction of food and material pursuits, and in 2009, TCM physical identification was incorporated into the national basic health service specification (Guan, Yang, & Guo, 2021; Lin, Li, & Hu, 2020). Physique is a form of organismal state formed by congenital inheritance or acquired, and is a stable characteristic inherent in the physical state and dynamic performance of human beings, which usually refers to a variety of internal elements including the level of physical development, cellular function, physical quality and psychological state (Deng, 2006; M. Wang, Li, & Dai, 2021). In ancestral medicine, there are nine types of constitution, namely, pingxin, qi deficiency, yang deficiency, yin deficiency, phlegm-damp, damp-heat, blood stasis, qi-depression, and special endowment (Tian, 2002). These nine constitutions reveal the future direction of human diseases and the pattern of yin and yang deficiency to the greatest extent, and provide important guidance for "treating the disease in the future" and clinical diagnosis and treatment programs in TCM. The study (X. Liu, 2010) found that the majority of the population in China has a biased body type, accounting for 67.86% of the population, while the remaining population has a calm body type, indicating that a large proportion of

the population is in a biased body type, and the body tends to develop in the pathological direction predicted by this body type. The identification of TCM constitution allows people to clearly understand their own constitution type and then to improve their habits such as eating habits and rules of work and rest, and to reduce the occurrence of diseases according to the characteristics of each constitution type. Identifying a certain body type can provide more people with treatment ideas and methods for "treating diseases before they occur", thus improving the health of all people and improving their health status for the benefit of more people (Crawford, Lancaster, Oh, & Rychtář, 2015).

In order to correctly apply the doctrine of constitution to help prevent disease and maintain health, the core issue is how to correctly determine the type of constitution. Therefore, the accuracy of the criteria for judging the constitution of Chinese medicine and the precision of the identification and classification will directly affect the efficacy of Chinese medicine in clinical practice. According to the characteristics of metabolism, the body type reflects more accurately the future development direction of human diseases and the law of yin and yang deficiency. As an important and indispensable organ of the human body, the tongue can be connected to the whole body through the meridians and the five internal organs. The nourishment of Qi, blood and fluid is the basis for the metabolism of all substances that determine the tongue (T. Liu, Lai, & Li, 2018; Yang, Chen, & Wang, 2019). Moreover, the tongue is extremely easy to observe and the features of the tongue can be seen with the naked eye only, and it is also the gateway to reflect the strength and weakness of the body's yin and yang qi and blood. Therefore, it is scientifically sound to use the tongue as a breakthrough point to reflect the strengths and weaknesses of cold, heat, qi and blood in the human body and to use it as one of the means of TCM physical identification (Durmić, Stević, Chatterjee, Vasiljević, & Tomašević, 2020).

In this study, we investigated the relationship between TCM physical constitution and tongue image based on physical constitution testing and tongue diagnosis to prove the feasibility of tongue image to identify TCM physical constitution and to find out the relevant factors affecting the identification of TCM physical constitution by tongue image. This study can lay a solid theoretical foundation for the future identification of TCM constitution by tongue image, and open up new ideas and methods for the research field of TCM constitution identification.

2. Research methodology

2.1 Research objects

The first-year students of a university in Ningbo were randomly selected as the research objects. Inclusion criteria: ① Those over 18 years old; ②

Those who have no obvious acute disease in the past 3 months, and who gave informed consent to the investigation. Exclusion criteria: ① Those who have serious organic lesions; ② Those who cannot extend their tongue normally to meet the conditions for taking tongue images; ③ Those who have incomplete physical health test data and traditional Chinese medicine tongue diagnosis records. A total of 1214 researchers were included, including 742 males and 472 females. Age 18 to 21 years old.

2.2 Research methods

2.2.1 Diagnosis of tongue image

In May 2018, the portable TCM tongue diagnosis instrument (XM-SX-IIIA) was used for image acquisition, and the tongue image analysis software was used to analyze the tongue image. The four aspects of shape, moss quality and moss color were manually identified and reviewed, and the final tongue diagnosis was made.

2.2.2 Physical fitness test

The test time was May 2018, and the test data was reported to the Ministry of Education. In accordance with the relevant provisions of the measurement criteria and scoring standards of the "National Student Physical Health Standard", the test is conducted using uniformly prescribed equipment and uniform methods. The test items are: body mass index (BMI), vital capacity, 50m, sitting forward bend, standing long jump, pull-up (men), 1-minute sit-ups (women), 1000m (men) and 800m (women). The overall score of students is rated as: 90 points and above are excellent, 80-89 points are good, 60-79 points are passing, and below 60 points are failing. According to the actual needs of the research, according to the total score of physical health, they were divided into the failing group (total score ≤ 60 points), the passing group (60 points≤total score≤79 points), and the excellent group (total score≥80 points).

2.3 Tongue signs of the nine types of constitution

By analyzing the 1214 cases of tongue images collected one by one, the distribution pattern of tongue images of the nine types of constitution was summarized from five aspects: tongue color, tongue shape, moss color, moss quality and fluid. Plain and Harmonious: The main manifestation is a pale red tongue with thin white moss, but also a red or pale white tongue with greasy moss and a fat or toothed tongue.

Qi deficiency: The main manifestation is a pale red or pale white tongue with thin white moss, which may be accompanied by greasy moss, fat and large with tooth marks and lubricated moss. Yang deficiency: The main manifestation is a fat tongue with a pale white color and thin white moss or teeth marks. Other

common manifestations include pale purple tongue, slippery moss or cracks.

Yin deficiency: The main manifestations are bright red or red-red tongue, little or no moss or light flaking, thin and small tongue, little fluid or cracks. It can also be seen with punctured tongue and thin yellow moss. Phlegm-damp quality: The main manifestation is a pale white tongue with thick and greasy moss and a fat, toothed tongue, which may also be accompanied by a light red tongue, a cracked tongue or a moist moss.

Damp-heat quality: The main manifestation is red or vivid tongue with yellowish greasy moss, but also fat tongue with tooth marks and moist moss. Blood stasis: The main manifestation is a blue or dark tongue, or petechiae, and a thin white moss. It can also be seen with red tongue and greasy moss. Qi-yu quality: The main manifestation is a light red tongue or red tongue with thin white moss. Endowment quality: light red or light white tongue, white or yellow moss. The tongue is fat and has teeth marks.

2.4 Data processing and analysis

Data analysis was performed using SPSS 20.0 software. The enumeration data were described by the number of people and percentages and the x^2 test was applied; the measurement data were described by the mean $\pm$ standard deviation; the research variables were coded by grade, and the variable Y (tongue color, tongue shape, coating quality, coating color) was assigned: yes= 1. No = 0; variable X (total physical fitness test score) assignment: fail group = 1, pass group = 2, excellent group = 3, and use binary logistic regression for analysis. P<0.05 was considered to be statistically significant.

3. Results

3.1 Physical fitness test

The physical fitness test items for college students were height, weight, lung capacity, step test, 50-meter run or standing long jump (choose one), grip strength or sit-up (female) or seated forward bend (choose one), and the score results are shown in Table 1. 146 (12.0%) of the 1214 college students were in the failing group, 848 (69.9%) were in the passing group, and 220 (18.1%) were in the excellent group, as shown in Table 2.

3.2 Distribution of tongue images in healthy groups with different physiques

3.2.1 Distribution of tongue color in healthy groups with different physiques

It can be seen from Table 3 that there were significant differences in the

light red tongue, pale white tongue and dark red tongue of healthy boys and girls with different physiques, and the cyanotic tongue of girls (P<0.05). For boys, the incidence of pale red tongue and dark red tongue in the failing group was significantly lower than that in the passing and excellent groups (P<0.05), and the incidence of dark red tongue in the failing group was significantly higher than that in the passing and excellent groups (P<0.05).

The appearance rate of pale tongue in the failing group and the passing group was significantly higher than that in the excellent group (P<0.05). For girls, the incidence of pale red tongue in the failing group was significantly lower than that in the passing and excellent groups (P<0.05). The incidence of pale red tongue in the passing group was significantly lower than that in the excellent group (P<0.05).

The occurrence rate of the pass group was significantly higher than that of the pass group and excellent group (P<0.05), the occurrence rate of pale tongue in the pass group was significantly higher than that of the excellent group (P<0.05), and the occurrence rate of dark red tongue in the failure group and pass group was significantly higher than that of the excellent group (P<0.05). P<0.05).

3.2.2 Tongue shape distribution in healthy groups with different physiques

Table 4 shows that there were significant differences in normal tongue shape, thin tongue, cracked tongue, tooth-marked tongue and pricked tongue among healthy boys and girls with different physiques (P<0.05). The appearance rate of normal tongue shape in male and female failing groups was significantly lower than that in pass group and excellent group (P<0.05).

Excellent group (P<0.05). The incidence rate of tongue prick in the failure group and pass group in boys was significantly lower than that in the excellent group (P<0.05), and the incidence of thin tongue in the pass group in girls was significantly higher than that in the excellent group (P<0.05). The rate was significantly lower than the excellent group (P<0.05).

3.2.3 Moss color distribution in healthy groups with different physiques

The results showed that there were significant differences in the yellow moss of healthy men and women, and the white moss and gray moss of girls (P<0.05). The occurrence rate of yellow fur in the failing group of boys was significantly lower than that in the passing and excellent groups (P<0.05), and the occurrence rate of yellow fur in the passing group was significantly lower than that in the excellent group (P<0.05). The incidence of white fur in the pass group of girls was significantly higher than that in the excellent group (P<0.05). Compared with the excellent group, the occurrence rate of yellow fur in the girls

failing and passing groups was significantly reduced (P<0.05). The occurrence rate of gray fur in girls was higher in the failing group than in the passing group, and lower in the passing group than in the excellent group, with significant differences (P<0.05), as shown in Table 5.

3.2.4 Distribution of moss quality in healthy groups with different physiques

The results showed that there were significant differences in thin fur, thick and greasy fur, and peeling/less fur/no fur in boys and girls with different physiques (P<0.05). The occurrence rate of thin moss in the unqualified group of boys and girls was lower than that of the pass group and the excellent group, and the occurrence rate of thin moss in the pass group of boys was lower than that of the excellent group, and the difference was significant (P<0.05).

The occurrence rates of thick and greasy fur and flaking/less furnishing/no fur in the failing group of boys were significantly lower than those in the passing and excellent groups (P<0.05), and the occurrence rates of thick and greasy fur in the failing group of girls were significantly lower than those in the passing and excellent groups (P<0.05). P<0.05), see Table 6.

3.3 Binary logistic regression analysis of physical health and tongue image

3.3.1 Regression analysis of physical health and tongue color

In the regression analysis of physical health and tongue shape, male and female pink tongue, pale white tongue, dark red tongue and female blue tongue have statistical significance (P<0.05), and the OR value is greater than that of male and female pink tongue. 1, all others are less than 1.

It indicated that male and female pink tongue was positively correlated with physical health (P<0.05), pale tongue and dark red tongue were negatively correlated with physical health (P<0.05), and female cyanotic tongue was negatively correlated with physical health (P<0.05), see Table 7.

3.3.2 Regression analysis of physical health and tongue shape

As shown in Table 8, in the regression analysis of physical health and tongue shape, male and female normal tongue, thin tongue, cracked tongue, toothed tongue, pricked tongue and male fat and big tongue were statistically significant (P<0.05).), the OR value indicated that male and female normal tongue shape, punctured tongue were positively correlated with physical health (P<0.05), thin tongue, cracked tongue, and tooth-marked tongue were negatively correlated with physical health (P<0.05), and male obesity was negatively correlated with physical health (P<0.05). Big tongue was negatively

correlated with physical health (P<0.05).

3.3.3 Regression analysis of physical health and moss color

As shown in Table 9, in the regression analysis of physique health and moss color, there was statistical significance between male and female yellow fur and female white fur (P<0.05). The OR value indicated that male and female yellow fur was positively correlated with physical health (P<0.05). <0.05), white fur in girls was negatively correlated with physical health (P<0.05).

3.3.4 Regression analysis of physical health and moss quality

As shown in Table 10, in the regression analysis of physical health and moss quality, boys with thin moss, thick and greasy moss, peeling/less moss/no moss, and girls with thick and greasy moss have statistical significance (P<0.05), and the OR value indicates boys Thin moss was positively correlated with physical health (P<0.05), thick and greasy moss, flaking/less moss/no moss was negatively correlated with physical health (P<0.05), and thick and greasy moss in girls was negatively correlated with physical health (P<0.05).).

3.4 Binary Logistic Regression Analysis of Influencing Factors of Normal Tongue Image of College Students

Normal tongue image refers to a tongue image with pale red tongue, normal tongue shape, white coating and thin coating. Among boys, 237 (31.9%) had normal tongue appearance, and 505 (68.1%) had abnormal tongue appearance; 216 (45.8%) and 256 (54.2%) females had normal tongue appearance and abnormal tongue appearance.

Taking the normal tongue image as the observation target, the body mass index (BMI), vital capacity, 50m, sitting forward bend, standing long jump, pull-up (male), 1-minute sit-ups (female), 1000m (male), Binary Logistic regression analysis was performed on the score of 800m (female), and it was concluded that the vital capacity of boys, sitting forward flexion, 1000m, standing long jump, 50m, and 800m of girls were the influencing factors of normal tongue image (P<0.05), and the corresponding OR value, Boys are 1.032, 1.010, 1.015, girls are 1.022, 0.975, 1.025, see Table 11.

4. Discussion

As an important part of the 5,000-year history and culture of the Chinese nation, Chinese medicine is an important part of the history and culture of the Chinese nation and is considered a national treasure. It shows a series of crystallization of wisdom of Chinese people in the process of facing and solving diseases, and its inheritance and development have made outstanding contributions to the health of people of all ethnic groups. Nowadays, with the

introduction of modern medicine into China in the late Qing Dynasty and the Republic of China, it has opened up people's horizons and given them more and more comprehensive choices in the pursuit of health. Its therapeutic effects are gaining more and more recognition. However, the development of Chinese medicine has its historical limitations and has not been better integrated into modern society, and its level of development has not fully met the needs of people for their own health in the new era, and its connotation value has not been fully released.

Tongue signs mainly include two aspects: tongue quality (tongue color, tongue shape) and tongue coating (tongue color, coating texture). The quality of the tongue mainly reflects the condition of qi, blood, fluid and the function of the internal organs. The change of tongue coating can reflect the cold and heat of the internal organs, the deficiency and reality, the nature of the pathogen and the depth of the disease location.

Our results showed that there were significant differences in abnormal tongue texture between healthy men and women with different body types: pale white tongue, dark red tongue, cyanotic tongue (female), thin tongue, cracked tongue, dentate tongue, and pierced tongue. logistic regression analysis showed that except for pierced tongue, other abnormal tongue textures were negatively correlated with body health, and the incidence reached the highest in the debilitated group.

Pale white tongue, dark red tongue, and blue tongue were mostly associated with Yang deficiency, Qi and Blood deficiency, and poor Qi and Blood operation. Studies (Liang, Wu, & Wang, 2010; Xu, Zhang, & Sun, 2004) claim that poor body mass is closely related to deficiency of qi and blood and deficiency of yin and yang, suggesting that dysfunction of qi and blood, body fluids, and internal organs may be the main reason for the increase of tongue abnormalities in college students with poor body mass. According to TCM, the tongue is the external condition of the hidden internal organs and has a direct or indirect relationship with the five internal organs (Du, Yang, & Liu, 2009). This study shows that tongue texture can reflect the health condition of the body.

In terms of abnormalities of tongue texture, the incidence of thick and greasy moss and flaking/low/no moss was significantly higher in boys and girls in the failing group than in the passing and excellent groups, and its incidence was negatively correlated with physical health status.

Thick greasy moss is mostly associated with dampness, phlegm, and food accumulation, and peeling/less/no moss is associated with both qi and yin of the stomach, which is a sign of poorly functioning and depleted qi of the spleen and stomach (Xin, Zhang, & Deng, 2020), suggesting that college students in the failing physical health group may have problems such as spleen

and stomach dysfunction. Punctured tongue indicates signs of blood heat or excessive internal yang heat.

Yang-heat hyperactivity implies excess Yang energy. According to TCM, "Yang hyperthermia leads to external heat" and belongs to the Yang-sensual constitution (Watari & Tokuda, 2018). The improvement of physical fitness may be related to an exuberant yang body and a strong body, which needs further research.

Heavy exercise is a prerequisite for obtaining athletic performance and a cause of fatigue. Studies (Luo et al., 2022) have shown that after heavy exercise, body fluids are depleted, heat gradually enters the body, and yellow moss increases significantly. The incidence of yellow moss was significantly higher in girls in the excellent group than in the failing and passing groups, which may be related to the increased intensity of exercise by students to improve their physical fitness. The smaller number of cases of gray moss in female students may be related to some hidden disease states, and further studies by expanding the sample are needed in the future (Cammarata-Scalisi et al., 2020).

Logistic regression results showed that when judging whether the tongue image was normal, the lung capacity, sitting forward flexion, 1000m for boys, standing long jump, 50m, 800m for girls were statistically significant. Boys' vital capacity, sitting forward flexion, 1000m OR value is greater than 1, girls standing long jump, 800m OR value is greater than 1, 50m OR value is less than 1, indicating that boys' vital capacity, sitting forward flexion, 1000m, girls standing long jump, 800m and normal tongue image Positive correlation, female 50m negative correlation with normal tongue image (Mészáros, Vasas, & Paczona, 2019).

It shows that when boys' lung capacity, sitting forward flexion, 1000m, girls' standing long jump, 800m are better, college students are more likely to show normal tongue image. The better the girls' 50m score is, the less likely the tongue image is to appear normal. This may be caused by the accumulation of thermal images in the body, and further studies are needed to expand the sample in the future.

5. Conclusion

To some extent, the constitution reflects the innate physical gifts of yin and yang, qi and blood, and susceptibility characteristics to disease. The human body's Yin, Yang, Qi, Blood and fluid are closely related to the function of the internal organs, and the tongue is the organ that communicates between the internal and external parts of the body, it is connected to the internal organs through meridians and lateral branches and depends on Qi, Blood and fluid for nourishment and moistening, and can be directly observed with the naked eye.

It is also a sensitive window reflecting the changes of Qi, blood and fluid in the internal organs.

At present, most scholars follow the criteria of Wang Qi's 09 edition questionnaire in the study of TCM physical identification, and the method is relatively simple. The research on TCM tongue diagnosis is mainly focused on clinical diagnosis and treatment and modernization and objectification of tongue diagnosis, and its application in TCM constitution determination is not comprehensive and rich enough.

In this paper, we introduce a new element of physique identification and combine it with traditional Chinese medicine consultation, which is in line with the research idea of combining the four diagnoses of TCM diagnosis and greatly improves the objectivity, feasibility and accuracy of TCM physique identification, and makes TCM physique determination more convenient, timely, objective, accurate, economical and efficient.

In this study, the results of the tongue image and the health status of college students were compared to identify the TCM constitution, and the relationship between the TCM constitution and the tongue image was investigated to prove the feasibility of the tongue image to identify the TCM constitution, and to find the relevant factors affecting the tongue image to identify the TCM constitution. This study can lay a solid theoretical foundation for the future identification of TCM constitution through tongue signs and open up new ideas and methods for the research field of TCM constitution identification.

However, during this study, we also found many shortcomings: (1) Usually, the clinical significance of tongue image corresponds to the evidence, which is characterized by dynamic changes, but the constitution is relatively stable. (2) The accuracy of tongue identification is not very stable. (3) There is no particularly perfect judgment standard for the identification by tongue image in the case of a combination of various physical conditions. (4) The sample size was small, and the samples were concentrated in college students. In future studies, we need to address these issues.

For example, the tongue image of the same sample should be collected several times at different time points, and the information of several tongue images should be combined to determine the physical condition of the sample; avoid collecting the tongue image immediately after eating, and the tongue image should be collected 2 hours after eating to prevent food contamination from staining the moss, which may affect the accuracy of the identification results.

A small number of questions should also be set, which should be used to help tongue identification when the tongue features are not obvious; further

research on the composition of tongue images of concordant body types to improve the accuracy of identification results; and continued data collection to expand the sample capacity and increase the sample data of different age stages. To lay a solid theoretical and practical foundation for a possible future intelligent TCM body identification system based on tongue analysis.

Data Availability

The simulation experiment data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Acknowledgments

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Table 1: scores of college students' physical health test items ($\bar{x} \pm s$)

SEX	BMI	LUNG CAPACITY	50M	SITTING	STAND	PULL UP	1MIN SIT UP	1000M	800M
M	93.48±11.55	87.18±14.82	76.42 ± 12.45	58.01 ± 24.91	59.76 ± 23.01	18.20±26.85	-	64.17 ± 14.93	-
F	96.53±8.43	87.33±13.49	68.34 ± 12.99	66.63 ± 22.17	68.42 ± 14.88	-	64.56 ± 16.38	-	69.79 ± 13.03

Table 2: Composition of physical fitness scores of college students [example (%)]

SEX	NO. OF PEOPLE	FAIL	PASS	EXCELLENT
M	742	120（16.2）	536（72.2）	86（11.6）
F	472	26（5.5）	312（66.1）	134（28.4）
Total	1214	146（12.0）	848（69.9）	220（18.1）

Table 3: Distribution of tongue color in healthy groups with different physiques [cases (%)]

	MALE						FEMALE					
	Pale red	Pale white	Red	Dark red	Cyan	Crimson	Pale red	Pale white	Red	Dark red	Cyan	Crimson
Fail	55(45.8)[B]	9(7.5)[c]	14(11.7)	26(21.7)[B]	6(5.0)	10(8.3)	12(46.2)[B]	6(23.1)[B]	0(0.0)	4(15.4)[C]	4(15.4)[B]	0（0.0）
Pass	349(65.1)	25(4.7)[C]	75(14.0)	34(6.3)	26(4.9)	27(5.0)	216(69.2)[C]	26(8.3)[C]	28(9.0)	19(6.1)[C]	11(3.5)	12（3.8）
Excellent	62(72.1)	0（0.0）	15(17.4)	4(4.7)	1(1.2)	4(4.7)	107(79.9)	4（3.0）	17(12.7)	2(1.5)	3(2.3)	1（0.7）
χ2	19.193	6.475	1.387	31.161	2.475	2.183	13.361	13.128	4.398	9.532	10.467	
P	< 0.001	0.039	0.500	< 0.001	0.290	0.336	0.001	0.001	0.111	0.009	0.005	0.145D

Note: B is compared with the pass group and excellent group; C is compared with the excellent group with statistical difference (P<0.05); D is Fisher's exact test

Table 4: Distribution of tongue shape (TS) in healthy groups with different physiques [cases (%)]

	MALE						FEMALE					
	(TS) Norm	(TS) BIG	(TS) Thin	(TS) Cracked	(TS) Scarred	(TS) Punctur	(TS) Norm	(TS) BIG	(TS) Thin	(TS) Cracked	(TS) Scar	(TS) Punctid
Fail	41（34.2）B	17（14.2）	22（18.3）B	18（15.0）B	19（12.5）B	7（5.8）C	8（30.8）B	4（15.4）	6（23.1）B	4（15.4）B	4（15.4）B	0（0.0）C
Pass	318（59.3）	53（9.9）	50（5.6）	43（8.0）	41（7.6）	51（9.5）C	191（61.2）	26（8.3）	27（8.7）C	16（5.1）	14（4.5）	38（12.2）
Excellent	53（61.6）	4（4.7）	4（4.7）	6（7.0）	2（2.3）	17（19.8）	92（68.7）	11（8.2）	3（2.2）	2（1.5）	2（1.5）	24（17.9）
χ^2	26.604	5.068	23.963	6.311	7.272	11.452	13.294	1.558	14.798	9.909	7.272	6.859
P	< 0.001	0.079	< 0.001	0.043	0.026	0.003	0.001	0.459	0.001	0.007	0.005	0.032

Note: *B is compared with the pass group and excellent group, C is compared with the excellent group and there is a statistical difference (P<0.05)*

Table 5: Distribution of moss color in healthy groups with different constitutions [cases (%)]

	MALE				FEMALE			
	White Fur	Yellow Fur	Grey Fur	Black Fur	White Fur	Yellow Fur	Grey Fur	Black Fur
Fail	107（89.2）	4（3.3）B	6（5.0）	3（2.5）	24（92.3）	0（0.0）C	2（7.7）A	0（0.0）
Pass	458（85.4）	49（9.1）C	25（4.7）	4（0.7）	295（94.6）C	16（5.1）C	0（0.0）C	1（0.3）
Ex	72（83.7）	14（16.3）	0（0.0）	0（0.0）	111（82.8）	20（14.9）	3（2.2）	0（0.0）
χ^2	1.479	10251	4.269	-	15.921	15.043	-	-
P	0.477	0.006	0.118	0.152 D	< 0.001	0.001	0.002 D	1.000 D

Note: *A is compared with the pass group, B is compared with the pass group and excellent group, C is compared with the excellent group with statistical difference (P<0.05); D is Fisher's exact test*

Table 6: Distribution of moss quality in healthy groups with different physiques [cases (%)]

GROUP	MALE					FEMALE				
	Thin Fur	Thick Fur	Greasy Fur	Thick/Greasy Fur	flaking/less Fur/no Fur	Thin Fur	Thick Fur	Greasy Fur	Thick/Greasy Fur	flaking/less moss/no moss
Fail	75(62.5)^B	8(6.7)	11(9.2)	11(9.2)^B	15(12.5)^B	16(61.5)^B	7(15.4)	0（0.0）	4(15.4)^B	2（7.7）
Pass	397(74.1)^C	46(8.6)	55(10.3)	11(2.1)	27(5.0)	256(82.1)	18(5.8)	22（7.1）	4(1.3)	12（3.8）
Excellent	76(88.4)	2(2.3)	6(7.0)	0(0.0)	2(2.3)	111(82.8)	14(10.4)	5（3.7）	2(1.5)	2（1.5）
χ^2	17.411	4.317	0.960	-	12.054	6.950	5.263	3.585	23.371	-
P	< 0.001	0.116	0.619	< 0.001 ^{D}	0.002	0.031	0.072	0.167	< 0.001	0.142 ^{D}

Note: B is compared with the pass group and excellent group; C is compared with the excellent group with statistical difference (P<0.05); D is Fisher's exact test

Table 7: Logistic regression analysis results of physical health and tongue color

TONGUE COLOR	MALE					FEMALE				
	Co-eff value(B)	Stats	P value	OR value	95.0%CI	Co-eff value(B)	Stats	P valu	OR value	95.0% CI
Light red tongue	0.608	16.392	< 0.001	1.838	1.369、2.467	0.684	11.703	0.001	1.982	1.339、2.933
Pale tongue	−0.822	6.184	0.013	0.440	0.230、0.840	−1.142	10.731	0.001	0.319	0.161、0.632
Red tongue	0.235	1.347	0.246	1.265	0.851、1.881	0.571	3.811	0.051	1.770	0.998、3.141
Dark red tongue	−1.183	22.159	< 0.001	0.306	0.187、0.501	−1.204	8.694	0.003	0.300	0.126、0.668
Blue purple tongue	−0.399	1.401	0.237	0.671	0.347、1.299	−1.079	5.275	0.022	0.340	0.135、0.854
Dark red tongue	−0.384	1.592	0.207	0.122	0.375、1.237	−0.557	1.075	0.300	0.573	0.200、1.642

Table 8: Logistic regression analysis results of physical health and tongue shape

TONGUE COLOR	MALE					FEMALE				
	Co-eff value(B)	Stats	P value	OR value	95.0%CI	Co-eff value(B)	Stats	P valu	OR value	95.0% CI
Normal tongue shape	0.630	18.300	< 0.001	1.878	1.407、2.508	0.558	9.281	0.002	1.748	1.220、2.503
Plump tongue	−0.522	5.012	0.025	0.593	0.376、0.937	−0.224	0.528	0.468	0.800	0.437、1.462
Thin tongue	−1.076	16.491	< 0.001	0.341	0.203、0.573	−1.265	12.876	< 0.001	0.282	0.141、0.563
Fissured	−0.530	4.734	0.030	0.589	0.365、0.949	−1.237	8.185	0.004	0.290	0.124、0.677
Teeth-marked tongue	−0.698	7.231	0.007	0.487	0.299、0.827	−1.265	7.863	0.005	0.282	0.117、0.683
Tongue piercing	0.734	9.658	0.002	2.084	1.311、3.311	0.634	6.155	0.013	1.886	1.142、3.112

Table 9: Logistic regression analysis results of physical health and moss color

TONGUE COLOR	MALE					FEMALE				
	Co-eff value(B)	Stats	P value	OR value	95.0%CI	Co-eff value(B)	Stats	P valu	OR value	95.0% CI
White Fur	−0.235	1.358	0.244	0.791	0.533、1.174	−1.043	11.390	0.001	0.352	0.192、0.646
Yellow Fur	0.789	10.122	0.001	2.202	1.354、3.582	1.250	13.689	< 0.001	3.491	1.800、6.769
Grey Fur	−0.554	2.564	0.109	0.574	0.291、1.132	−0.102	0.015	0.904	0.903	0.173、4.712
Black Fur	−1.358	3.642	0.055	0.257	0.064、1.032	−0.822	0.185	0.667	0.440	0.010、18.651

Table 10: Logistic regression analysis results of physical health and moss quality

TONGUE COLOR	MALE					FEMALE				
	Co-eff value(B)	Stats	P value	OR value	95.0%CI	Co-eff value(B)	Stats	P valu	OR value	95.0% CI
Thin Fur	0.675	16.870	< 0.001	1.964	1.423、2.710	0.361	2.603	0.107	1.434	0.926、2.223
Thick Fur	−0.240	0.826	0.363	0.787	0.469、1.320	0.184	0.326	0.568	1.202	0.639、20262
Greasy Fur	−0.095	0.161	0.688	0.910	0.573、1.445	−0.162	0.190	0.663	0.850	0.410、1.764
Thick/Greasy Fur	−1.665	16.102	< 0.001	0.189	0.084、0.427	−1.605	6.739	0.009	0.201	0.060、0.675
Flaking/less Fur/no Fur	−0.953	10.510	0.001	0.386	0.217、0.686	−0.855	3.022	0.082	0.425	0.162、1.115

Table 11: Logistic regression analysis results of factors affecting the physical health of normal tongue image of college students

MALE						FEMALE					
Var	Co-eff value(B)	Stats	P value	OR value	95.0%CI	Var	Co-eff value(B)	Stats	P valu	OR value	95.0% CI
Lung capacity	0.032 -	22.315	< 0.001	1.032	1.019、1.046	Standing long jump	0.022	7.916	0.005	1.022	1.007、1.037
Sitting forward	0.010	7.460	0.006	1.010	1.003、1.018	50-meter run	−0.025	5.629	0.018	0.975	0.955、0.996
1000 meters	0.015	7.865	0.005	1.015	1.005、1.026	800meter run	0.025	9.539	0.002	1.025	1.009、1.042
Constant	−5.137	53.091	< 0.001	0.006	-	constant	−1.645	7.350	0.007	0.193	-